



Ada Lovelace: Imagining the Analytical Engine

Saturday 2 November 2019 6.30pm,
Milton Court Concert Hall

Emily Howard Ada sketches

interval 20 minutes

Patricia Alessandrini Ada's Song

Shiva Feshareki Perpetual Motion (in two contrasting movements)

Emily Howard But then, what are these numbers?

PRISM Team led by Robert Laidlow Alter

Emily Howard curator

Marta Fontanals-Simmons mezzo-soprano

Britten Sinfonia

William Cole conductor

Ursula Martin, Sydney Padua & Conrad

Shawcross panellists

Andrew McGregor compere

All the music in this concert apart from Emily Howard's 'Ada sketches' has been commissioned by the Barbican and receives its world premiere tonight



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The music will be introduced by the composers with contributions from the panellists

Part of Barbican Presents 2019–20

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Welcome

Welcome to tonight's event, part of the Barbican's Life Rewired, which explores what it means to be human in an era when technology is changing everything. This evening we celebrate the extraordinary gifts of Ada Lovelace, a 19th-century visionary who is best remembered for publishing the first computer programme in an era when such machines were merely the stuff of dreams. But just as important were Ada Lovelace's musical interests; she played several instruments and was fascinated by the possibilities of the language of music itself.

Emily Howard is a composer who shares those parallel interests in music and mathematics and so we're delighted that she has curated this evening's concert. Two

of her works are being performed tonight, both inspired by Lovelace. Alongside these are new pieces by Patricia Alessandrini, Shiva Feshareki and the PRiSM team led by Robert Laidlow, commissioned by the Barbican and receiving their world premiere performances, given by Britten Sinfonia and rising mezzo-soprano Marta Fontanals-Simmons.

In addition to music, there is discussion from a suitably wide-ranging panel of creative thinkers.

It promises to be an extraordinarily enlightening experience. I hope you enjoy it.

Huw Humphreys
Head of Music

Tonight's curator Emily Howard on Ada Lovelace

Ada Lovelace's visionary contribution to humanity has had a significant and growing influence on my own creative output, and on my love of collaboration with mathematicians and scientists, ever since I composed *Ada sketches* (2011), the first work you will hear in tonight's programme.

Lovelace, a pioneer of computer programming, is quite rightly now celebrated as an important role model for women in science, technology, engineering and mathematics. My hope is that tonight's event will also encourage us to think about the importance of Lovelace's inherent interdisciplinarity. I do believe it was her artistic inclinations in combination with her scientific ones that enabled her to make such giant creative leaps, leading to perceptions well ahead of her time. Her abundant love for music (she played the harp and flute, and wrote about singing arias from Bellini's *Norma*) gave Lovelace the language in which she communicated her prescient programming vision that computers might eventually do more than process numbers by composing 'elaborate and scientific pieces of music of any degree of complexity or extent'.

It has been a real privilege to curate and contribute to this evening's Barbican event 'Ada Lovelace: Imagining the Analytical Engine' and I

would like to thank everyone who has been involved in the project. Throughout the process, one question has been at the forefront of my mind: 'What might today's Ada Lovelace be imagining about the future of technology, and implicitly, about the future of humanity?' There must be somebody thinking right now about something that is going to change everything and I wonder what that visionary is thinking ...

It has been my hope that, by inviting leading composers Patricia Alessandrini and Shiva Feshareki, together with renowned Lovelace experts across different disciplines – mathematician Ursula Martin, graphic author Sydney Padua and artist Conrad Shawcross – as well as a ground-breaking team of musicians and scientists led by composer Robert Laidlow from PRiSM (the Centre for Practice & Research in Science & Music based at the Royal Northern College of Music) to work with outstanding performers Marta Fontanals-Simmons and Britten Sinfonia, we may bring together music and science, in the spirit of Ada Lovelace, and share experiences across disciplines that will lead to new insights for all of us.

© Emily Howard

Composer Emily Howard is Director of PRiSM, the Centre for Practice & Research in Science & Music based at the Royal Northern College of Music.

Meet Ada Lovelace

Laura Tunbridge, librettist of 'Ada sketches', reveals the woman behind the myth

Ada Lovelace, as she is commonly known, referred to herself as undertaking 'poetical science'. It is an apt description for someone whose father was the renowned poet Lord Byron and who, under the influence of her mother Lady Annabella Milbanke, demonstrated from childhood considerable mathematical ability.

Born on 10 December 1815, just a few weeks before her parents separated, Ada had a difficult childhood beset by illness and the scandals that surrounded her father, many of which were spread by her mother. Ada never met Lord Byron, who left England for good in 1816 and died in Greece when she was 8 years old. Determined to prevent her daughter from developing Byronic behavioural patterns, Annabella devised for her a rigorous educational programme that brought in a string of well-qualified tutors to discipline her mind. They included Cambridge scholar William Friend, who gave Ada instruction in astronomy, algebra and geometry, and Augustus De Morgan, the first Professor of Mathematics at the newly founded University of London (now UCL). Music was also considered an important skill and she learnt to play the flute and the harp. While Ada on occasion still behaved badly, even madly, she was extremely well educated and, by her late teens, had unusual renown as both a socialite and a mathematician.

Another of Ada's tutors was the eminent scientist Mary Somerville, who introduced Ada to the inventor and mathematician Charles Babbage in June 1833. Ada was intrigued by Babbage's new calculating machine, the Analytical Engine, and they developed a close working

relationship; Babbage famously described her as 'the enchantress of number'. In 1840 Babbage had given a lecture at the University of Turin, which a young Italian, Luigi Menabrea, translated into French; it was published in the *Bibliothèque universelle de Genève* in 1842. Ada was asked to translate the article into English. She did so and supplemented the article with extended notes, labelled A to G, in which she explained the potential of the machine to go beyond pure calculation and proposed how an algorithm might be processed to compute a table of Bernoulli numbers. Her article was published in Taylor's *Scientific Memoirs* in September 1843, under the initials A A L: a reminder that it was still considered inappropriate for a woman to have a profession. It is on the basis of the 'Notes to the Analytical Engine' that Ada's work was hailed in the next century as a forerunner of computer programming.

Ada had married Lord William King in 1835; he was made Earl of Lovelace in 1838, meaning that technically Ada should be referred to as Lady Ada King, Countess of Lovelace rather than the more colloquial Ada Lovelace. The family had several residences: Ockham Park in Surrey, a Scottish estate on Loch Torridon, a house in London, and Worthy Manor in Ashley Combe, Somerset. They had three children: Byron (1836–1862), Annabella (1837–1917) and Ralph Gordon (1839–1906). Yet despite all her achievements, Ada's relationship with her own mother became ever more rancorous. In 1841, Annabella revealed that Byron was the father of Medora Leigh (daughter of the poet's half-sister Augusta) with whom Ada had struck up a friendship. The decade was marked by further infamies, from Ada's own extra-marital affairs

to her pronounced gambling habit, through which she lost a great deal of money and even family jewels.

Throughout all this personal tumult, Ada continued to engage imaginatively with scientific ideas. She wrote to Babbage in 1843: 'The more I study, the more irresistible do I feel my genius for it to be. I do not believe that my father was (or ever could have been) such a Poet as I shall be an Analyst (& Metaphysician).' The following year she expressed her interest in creating a mathematical model for how the brain and nerves produce thoughts and feelings, which she described as 'a calculus of the nervous system'. She attempted, disastrously, to devise a large-scale betting system. While Ada's curiosity about phrenology and mesmerism now seems more like hocus-pocus

than hard science, she was not alone in her interests during the 19th century.

Ada suffered several periods of illness throughout her life; her last months were overtaken by uterine cancer, of which she died on 27 November 1852. Annabella reasserted her power over her opium-riddled daughter during her final illness, restricting who could see her and encouraging her religious conversion. Relations with Ada's long-suffering husband were broken off. Yet in 1850 Ada had visited the Byron ancestral home, Newstead Abbey in Nottinghamshire, and somehow made peace with her ancestry. At her request, she was buried in the family vault, next to her father.

Programme note © Laura Tunbridge

Emily Howard (born 1979)

Ada sketches (2011)

Marta Fontanals-Simmons mezzo-soprano

Composed in 2011, *Ada sketches* is a short dramatic scena for mezzo-soprano and chamber ensemble that imagines an inner world of mathematician Ada Lovelace. The work is concerned with creative processes as Lovelace (represented by the mezzo-soprano) experiences a number of different creative discoveries as she explores a mathematical equation solved by Charles Babbage's hypothetical 1842 Analytical Engine, a prototype for the world's first computer. As she works, a musical solution to the equation gains a life of its own, causing Lovelace to contemplate her own position in history.

I will always be grateful to musicologist (and *Ada sketches* librettist) Laura Tunbridge for suggesting Lovelace as an opera subject that might resonate strongly with me because of my own interest in science and mathematics. That was over a decade ago and I subsequently spent a serious amount of time with Lovelace's translation of Luigi Menabrea's 'Sketch of the Analytical Engine

Invented by Charles Babbage' (1842), and even longer with the accompanying and visionary 'Translator's Notes' with their far-reaching contributions to future computing.

At around 20 000 words, Lovelace's Notes more than compensate for the paper she was not permitted to write in the male-dominated scientific world of her time. There are several elegant mathematical explanations presented alongside conceptual speculations of great insight. These include the following prescient vision of modern computing that strongly influenced *Ada sketches*:

'Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the Engine might compose elaborate and scientific pieces of music of any degree of complexity or extent.'

Ada sketches is one of three works collectively titled *The Lovelace Trilogy*, alongside the piano concerto *Mesmerism* and the orchestral work *Calculus of the Nervous System* (both 2011). Lovelace dabbled in mesmerism, a forerunner of hypnosis developed by physician Franz Mesmer, and wrote that she wished to develop a 'calculus of the nervous system': a mathematical model for how the brain could give rise to thought, and nerves to feelings.

Ada sketches was first performed in concert by Loré Lixenberg (Lovelace), Rowland Sutherland (flute), Tom Lessels (clarinet) and Adam Clifford (percussion) at the Austrian Cultural Forum, London on 12 May 2011. It received a first staged performance (Lixenberg) at the Royal Opera House's Linbury Studio. The work lasts approximately 7 minutes.

Programme note © Emily Howard

Text

Adasketches

Suppose that a equals three, b equals two and n equals thirty-six.
We must now put into the engine the cards proper for directing the operations.
Of course, we could divide three by two and multiply the answer by itself thirty-six times.
But, the number of steps can be reduced.
Three by two by itself to give three by two squared.
Again by three by two to get three by two cubed.
Three by two cubed by three by two squared gives three by two to the power of five.

And so on,
to the eight,
thirteen,
...
Thirty four.

The powers follow a fibonacci sequence suppose, just suppose instead of numbers there are notes.
Fundamentally related,
Harmonically concatenated.
Then the engine, the engine might compose music.
Elaborate music.
Scientific music

Where will I fit in?
When the engine composes its melodies, will the world remember my name?
Will Ada resonate as if struck by a tuning fork?
Calculated! Calibrated! Celebrated!
Universally celebrated!
I am music I am madness I am machine making the future.

But, I'm getting ahead of myself.
Multiply by a final three by two squared to get three by two to the thirty-six.
In all, two divisions and eight multiplications to complete the whole process.
We may represent them thus:-

Patricia Alessandrini

Ada's Song (2019) world premiere

Marta Fontanals-Simmons mezzo-soprano

Ada's Song is for mezzo-soprano, ensemble and interactive piano machine.

Ada Lovelace is credited with the first published imaginings of Artificial Intelligence (AI) applied to the creation of music: she chose composition as an example in which 'mutual fundamental relations could be expressed by those of the abstract science of operations', such that a machine could 'compose elaborate and scientific pieces of music of any degree of complexity or extent'. Over 150 years later, we are still exploring questions about the nature of music made using AI: its 'complexity or extent'; what distinct qualities may be achieved using AI beyond verisimilitude to human composition; and what music created using AI may be able to tell us about how humans learn to compose, how style is formulated, and the nature of expressivity.

Ada's Song takes as a prompt Lovelace's theorisation of notions of AI, its possibilities – including composing music – and limitations, and explores AI-assisted composition and its relationship to interpretation and expressivity in music. First of all, I used AI to create a score, in a process related to my previous works which interpret existing pieces of music. This process involves choosing a piece, finding multiple recordings of it, mixing these together and then making a transcription of this mix, using various means to heighten the differences between them.

On this occasion, I chose Henry Purcell's *Hosanna to the highest*: the fluidity of the melody over the regularly repeating ground pattern, its rendering of a poetic and unusual text, and the large degree of difference in the interpretations all made it an interesting subject for an exploration of expressivity. Rather than manually mixing the different recordings together, I used a similarity algorithm to match automatically note-by-note segments of several recordings to one instrumental transcription without voice.

This caused a radical reordering of the notes, as various instantiations of the melody over the repeated ground became shuffled; while the harmonic progression was preserved the sung text was completely reordered, creating new melodic relationships and combinations of words. I then mapped excerpts from Ada Lovelace's letters onto the newly created text. I applied a second AI process that automatically orchestrated the newly created phrases.

In addition to using AI to generate musical material, *Ada's Song* employs a 'piano machine' in an attempt to make real-time machine learning process tangible, while exploring the particularities of human expression: a machine-learning processes 'listens' to the instrumentalists during the performance and responds by 'playing' the piano through an automata system according to what it has 'learned', in terms not just of what notes have been played, but of how they have been performed. The music created by the machine-learning process is physically distinct from the performance of the musicians, yet inscribes itself in the sonic world of the ensemble's line-up. Marta Fontanals-Simmons plays a key role in this process, as the machine-learning system also generates new material for her to sing in real time; her interpretation of this new material then in turn influences the piano machine's musical responses over the course of the performance. Rendering human expressivity perceptible in machine-learning processes and highlighting the performer's agency in determining the results of it is in keeping with Ada Lovelace's theorisation of the relationship between humans and that which we programme: 'The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform.' Her recognition of human responsibility and agency is one among many vitally important contributions of her work informing current discussions of AI.

Ada's Song is dedicated to Marta Fontanals-Simmons, with gratitude for her spirit of experimentation and invention. The piano machine was created in collaboration with Konstantin Leonenko at Goldsmiths Hatchlabs; the first version of it was commissioned by Explore

Ensemble with funding from the Arts Council England and support from the Huddersfield Contemporary Music Festival.

Programme note © Patricia Alessandrini

Shiva Feshareki (born 1987)

Perpetual Motion (in two contrasting movements) (2019) world premiere

Ada Lovelace reflected on the creation of Artificial Intelligence, in the dawn of the programming age, through her devising of the first algorithm and, more specifically, her writings on the unrealised Analytical Engine.

Rather than becoming consumed by the mechanical nature of programming and code Lovelace understood 'intrinsic beauty, symmetry and logical completeness' in their mathematical underpinnings. She further believed mathematics was a language which could be used to read nature and the universe. Through her work she felt 'immense development of imagination' – so much so that 'I feel no doubt if I continue my studies I shall in due time be a Poet'.

Shiva Feshareki's composition comments on the contemporary perpetual motion of technological culture, but as Lovelace would have implored us to do so. Today technology consumes itself by mechanising and replicating human labour, thought and even creativity without stopping to find beauty and poetry in either our human capabilities or the technologies we've created.

A musically notated score is inherently algorithmic as players perform and make audible transcribed instructions. For Movement I of *Perpetual Motion* Feshareki reinforces the mechanical nature of performance but, in its complete composition and projection of sonic energy to the listener's ear, expresses the poetry that sound affords us by not

reducing notation to pure information. Instead the permeating, mathematical yet ethereal qualities of the harmonic series are exploited to contour the resonance between player, instrument and environment.

Today sophisticated synthesised voices, enabled by AI, compose strings of segmented sounds into speech. This in turn reveals the mechanics of voice, breaking the spell of expression, unravelling speech as tonal code that can be assembled into sense and substance by humans. By exposing the sonic system of the voice at work in language-making it enables us to both reproduce it synthetically and comprehend it as a material to be shaped and sculpted to create new expressive possibilities in vocal formation and communication.

For Movement II of *Perpetual Motion* the composer explores Lovelace's intention that 'I shall in due time be a Poet', digitally shaping Lovelace's words, spoken by Feshareki herself, into new poetic formations, through a process of moving from speech to sound; making malleable and manipulating the original recorded phrase. Feshareki offers her own voice to complete Lovelace's augury that 'poetry in conjunction with musical composition' would be her 'destiny' or 'ultimate line'.

Research, text and narrative development
by Amina Abbas-Nazari

Emily Howard

But then, what are these numbers? (2019) world premiere

Marta Fontanals-Simmons mezzo-soprano

But then, what are these numbers? (2019) is a setting of a little-known letter penned by Lovelace to her mother. Below is a transcription with Lovelace's own underlinings. The words in bold are underlined twice.

London Weds afternoon 29th Oct

Some of the conversation between us this morn'g, on general topics, has been like a special watering to a certain seed which is sprouting, (but as yet has not reached the surface of the soil)!

If I could ever help to give the despots a shove, I should certainly feel that I had not lived in vain.

Your hope, & expectation almost, that such a day may arrive, gives me great encouragement.

I think, when you do bye and bye see certain productions, you will not even despair of my being in time an Autocrat, in my own way; before whose marshalled regiments some of the iron rulers of the earth may even have to give way!

But of what materials my regiments are to consist, I do not at present divulge. I have however the hope that they will be most harmoniously disciplined troops; consisting of vast numbers, & marching in irresistible power to the sound of music. Is not this very mysterious? Certainly my troops must consist of numbers, or they can have no existence at all, & would cease to be the particular sort of troops in question. But then, what are these numbers?

Although we do not know exactly when this letter was written, some believe it was in 1851, the year before Lovelace died of uterine cancer at the age of 36. I was immediately struck by these seemingly disconnected sentences, tantalising glimpses through to a fuller conversation between mother and daughter. Without context, I found the effect of these sentences as a whole not dissimilar to the effect of the texts that have

been resulting from training AIs on Lovelace's published writing, a project led by my PRISM colleague David De Roure. And the range of emotions that sprang out at me – different for each sentence: humorously with slight vexation, poignantly, sincerely, with increasing arrogance, mysteriously, ever more fantastical, enigmatically, with conviction, thoughtfully – made their way straight into the score as performance directions.

I am drawn to the contradictory nature of this letter, and indeed much of Lovelace's life. Her complex relationship with her family, fame and fortune can be set against her own passions: an abundant love for music and her serious commitment to mathematics at the highest level.

Lovelace's joyous interest in playing with new mathematical ideas is exemplified by an undated manuscript in the hands of Lovelace and Babbage in which they explore the rules underlying patterns in networks, rules which are the precursor of fundamental ideas in modern artificial intelligence. In a nod towards this, I have dissected, randomised and reordered the text of this letter using algorithms from the earliest days of computing that form the very foundation of modern artificial intelligence. Underpinned by music moving through similar variations and progressions, the musical iterations culminate in the letter's correct order and, paraphrasing Lovelace's own words to her mother, harmonious discipline in the final act.

Huge thanks to Ursula Martin for drawing my attention to Ada Lovelace's letter in the first place, to Ursula and David De Roure for so many helpful discussions about Lovelace and her work, and to Marta Fontanals-Simmons for conversations during the creation of the work. It is dedicated to Marta and Britten Sinfonia and lasts approximately 10 minutes.

Programme note © Emily Howard

PRiSM Team led by Robert Laidlow

Alter (2019) world premiere

Alter is written about, and utilising, artificial intelligence. Through three phases, it traces the development of an artificial mind: from hazy, unformed conception to a complex and creative self. Between each phase this curious and perfectionist mind dives into its own code to retrain and develop itself.

Linking the imagined technology with the real, the text is entirely written by an AI that audibly develops in coherence and philosophical scope. At first, it merely learns from Ada Lovelace's correspondence. This is expanded to wider 19th-century writing and finally the extent of the Internet through OpenAI's GPT-2 algorithm. In this way the narrative of the scene reflects the data science behind its production.

The music (as far as the two can be separated) also uses AI in a number of ways: sometimes behind the scenes to inform large-scale decisions, sometimes locally where entire phrases are composed by AI. Material written by AI becomes ever more prominent until the texture becomes a simmering collage of overlapping machine-created ideas. The piece also includes electronics: first in recordings of voices that do not exist, produced by DeepMind's WaveNet, and later becoming a true digital counterpart to the carbon-based life forms of Britten Sinfonia.

The percussionist is directed to use the 'Lovelace Engine', a hand-turned percussion battery styled after Charles Babbage's 19th-century Difference and Analytical Engines, the latter written about at length by Lovelace. An important part of this project lies in imagining the future that Lovelace

and her contemporaries may have seen – one of computers formed of gears, mechanism, industry – and juxtaposing that with the reality of AI today.

Alter is a PRiSM commission led by Robert Laidlow. The music was composed by Robert Laidlow, partially incorporating music generated by MuseNet Music Transformer (OpenAI), designed and provided by Christine Payne. The text was written by artificial intelligence developed using datasets coded by David De Roure (Oxford University) at The Alan Turing Institute, and by OpenAI's GPT-2, trained upon Lovelace's correspondence provided by Ursula Martin (Oxford and Edinburgh University). It was edited and structured by Robert Laidlow. The Lovelace Engine was designed and built by Jonathan Morris with assistance from Cambridge Design Partnership and the Arts and Humanities Research Council. Emily Howard is the director of PRiSM, the RNCM Centre for Practice & Research in Science & Music, and provided curatorial guidance throughout the work's creation.

In the creation of 'Alter', commissioned by the Barbican, the PRiSM team gratefully acknowledges support from The Alan Turing Institute, the Electronic Enlightenment team at the Bodleian Libraries, Oxford, the FAST programme grant funded by the Engineering and Physical Sciences Research Council, the North West Consortium Doctoral Training Partnership funded by the Arts and Humanities Research Council, Cambridge Design Partnership, and Research England.

Composer Robert Laidlow is the PRiSM Researcher in AI-Assisted Composition in Association with the BBC Philharmonic.

About the composers



Sam Fairbrother

Emily Howard

Emily Howard

Emily Howard's music is known for its particular connection with science. Her 2016 BBC Proms commission *Torus*, described by *The Times* as 'visionary' and by *The Guardian* as 'one of this year's finest new works', won the orchestral category of the 2017 British Composer Awards. BBC Radio 3's *Record Review* described her NMC debut disc *Magnetite* as 'a confident, major orchestral debut', hailing it for its brilliantly articulated scientific ideas.

Magnetite (premiered by the Royal Liverpool Philharmonic Orchestra/Vasily Petrenko) was commissioned by Liverpool European Capital of Culture 2008 and first won Howard critical acclaim in the same year that she received the Paul Hamlyn Foundation Award for Composers.

Subsequent works include *Solar* (London Symphony Orchestra/Nicholas Collon, 2010); *Calculus of the Nervous System* (Vienna Radio Symphony Orchestra/Sir James MacMillan; Wien Modern 2011; and City of Birmingham Symphony Orchestra/Andris Nelsons, BBC Proms 2012); *Mesmerism* (2011), commissioned for pianist Alexandra Dariescu, which won a 2012 British Composer Award; *Axon* (BBC Philharmonic/Juanjo Mena; 2013); *Afference* (Elias Quartet, 2015); *sphere* (Bamberg Symphony Orchestra/Alondra de la Parra; 2017); *The Music of Proof* (Piatti Quartet, mathematician Marcus du Sautoy, New Scientist Live 2017); and mini-operas *Ada sketches* (Royal Opera House

Linbury Theatre, 2012) and *Zátopek!* (New Music 20x12, London Cultural Olympiad).

Howard was a featured composer at the Aldeburgh Festival 2018 with the world premiere of her opera *To See The Invisible*, an Aldeburgh Festival commission. This year sees three world premieres: *The Anvil: An Elegy for Peterloo*, a major new work for orchestra, chorus and soloists with a text by Michael Symmons Roberts, commissioned by Manchester International Festival and the BBC Philharmonic; *But then, what are these numbers?* as part of today's celebration of the legacy of Ada Lovelace curated by the composer with Britten Sinfonia; and a new orchestral score, *Antisphere*, for Sir Simon Rattle and the London Symphony Orchestra which opened their 2019–20 season.

emilyhoward.com



Pete Wood

Shiva Feshareki

Shiva Feshareki

Shiva Feshareki is a critically acclaimed composer and turntablist, and NTS Radio DJ. Her diverse output explores electronics, acoustics, context and perspective through wide-ranging practices that incorporate classical craft and experimental methodology. She received the 2017 British Composer Award for Innovation from the Ivors Academy and the Royal Philharmonic Society Composition Prize (2009), as well as the BBC Young Composer Award (2004) with her first scored composition. A host of performances

followed including, most recently, at the Moscow Museum of Modern Art, BBC Proms, London Jazz Festival and at the Spitalfields Festival, where she was Featured Artist.

Other recent highlights include Saturnalia at Macao (Milan), Hyperreality Festival of Club Culture (Vienna), Mutek (Montreal), Sonar (Barcelona), Maerzmusik (Kraftwerk, Berlin), The Tanks at Tate Modern (London), Artheater/ Frau Musica Nova (Cologne), Appia Stage (Hellerau), The Pumphouse (Aldeburgh), Southbank Centre 'Concrete Lates' Takeover (London) and Nikolaj Kunsthal (Copenhagen) as part of Haroon Mirza's installation *Dancing with the Unknown*. 2019 also saw the release of her debut album *NEW FORMS* – a snapshot into her turntabling experiments – and new single release 'Vapour', created through her live turntabling using the vinyl disc of *NEW FORMS*.

Her solo turntable performances fuse together sonic palettes using hyper-physical electronic manipulations and sampling techniques. Cuts from drum and bass, garage, gabber, deep minimalism and classical orchestral works are used to create complex live compositions that are as kinetic as they are delicate.

She also composes extensively for orchestras, recently working with the BBC Concert Orchestra, the Aarhus and Düsseldorf Symphony orchestras, London Contemporary Orchestra and Orchestre National de Lyon.

Her compositional work explores the physicality of sound in relation to light, sculpture and movement. *GABA-analogue* (2017) employed space as a compositional tool to create a surround-sound orchestra inside London's Printworks nightclub with the London Contemporary Orchestra. Her composition *Dialogue* (2018) for Live Turntable Manipulation and Orchestra was premiered at the Queen Elizabeth Hall during the EFG London Jazz Festival with the BBC CO, and received three more performances this year from the Orchestre National de Lyon and BBC CO (PRS New Music Biennial). Forthcoming premieres include *Opus Infinity*: a large-scale composition for Turntables and Spatialised Ensemble to be premiered by Shiva Feshareki and Ensemble Modern in 2020 (Frankfurt LAB).



Patricia Alessandrini

Patricia Alessandrini

Patricia Alessandrini is a composer/sound artist who creates compositions, installations, and performance situations which are for the most part interactive and theatrical. Through these intermedial formats, she actively engages with the concert-music repertoire, and issues of representation, interpretation, perception and memory. Her works are often collaborative, and engage with social and political issues. She performs research on embodied interaction and immersive audiovisual experience, including instrument design for inclusive performance.

Her works have been presented in the Americas, Asia, Australia and over 15 European countries, at festivals such as Archipel, Donaueschinger Musiktage, Electric Spring, HCMF, Heidelberger Frühling, Gaudeamus, Mostly Mozart, Musica Strasbourg, Rainy Days, Salzburg Biennale and Sonorities. She is also a performer and improviser of live electronics.

She was Composer-in-Residence at the 2010 soundSCAPE festival, and featured in ICELab with the International Contemporary Ensemble in 2012. She was awarded first prize in 2009 in the Sond'Arte Composition Competition for Chamber Music with Electronics, and a Development Prize in Composition by the Darmstadt Summer Course in 2012. In the 2015–16 season she was featured as a composer, curator and educator in four concert and outreach events with the Ensemble Intercontemporain, as part of the Sound Kitchen series at the Gaîté Lyrique, a centre for digital arts in Paris.

She studied composition and electronics at the Bologna and Strasbourg conservatories and IRCAM, and holds two PhDs – from Princeton

University and the Sonic Arts Research Centre (SARC) respectively. She has taught Advanced Computer-Assisted Composition at the Scuola superiore of the Accademia Musicale Pescarese and Composition with Technology at Bangor University, and has worked as a Lecturer in Sonic Arts at Goldsmiths, University of London, and in 2018 was appointed Assistant Professor of Composition at Stanford University, where she also performs research at the Center for Computer Research in Music and Acoustics (CCRMA).

Her works are published by Babelscores and may also be consulted at patriciaalessandrini.com



Robert Laidlow

Robert Laidlow

Robert Laidlow is the PRiSM Researcher in AI-Assisted Composition at the Royal Northern College of Music, in partnership with the BBC Philharmonic Orchestra, supported by the AHRC North West Consortium Doctoral Training Partnership and the National Productivity Investment Fund. His music focuses on incorporating original research, conducted with a range of cross-disciplinary collaborators, into the compositional process. His works have been performed and broadcast worldwide and have received national and international awards, including a nomination for the British Composer Awards.

His string quartet *Aroha* was premiered by the Elias Quartet at the Wigmore Hall in May this year and broadcast on BBC Radio 3, while his *Three Entistatios* for Chamber Ensemble was performed by the BBC Philharmonic at the University of Salford Research Festival in July. His music has also been performed by groups including Ensemble Modern, the Bournemouth Symphony Orchestra, Psappha and the Berkeley

Ensemble and has been commissioned by organisations including the Royal Philharmonic Society, the Campos do Jordao Music Festival and Access Contemporary Music Chicago.

www.robertlaidlow.co.uk

PRiSM

PRiSM is the Centre for Practice & Research in Science & Music at the Royal Northern College of Music, directed by Emily Howard (Professor of Composition, RNCM) and co-directed by mathematician Marcus du Sautoy (Simonyi Professor for the Public Understanding of Science and Professor of Mathematics, University of Oxford). PRiSM brings together researchers and practitioners in composition, performance, Artificial Intelligence, mathematics, music perception and data science to foster and promote world-leading research through creative collaborations between the sciences and music.

The Centre was launched in October 2017, and in 2019 was awarded nearly £1,000,000 from Research England's Expanding Excellence in England Fund to support and augment its research. PRiSM takes a lead in interdisciplinary and reflexive research between the creative arts and the sciences with a view to making a real contribution to society, to developing new digital technology and creative practice, and to addressing fundamental questions about what it means to be human and creative today.

PRiSM events include world premieres and research publications, along with workshops, festival appearances and the use of cutting-edge technology including the PRiSM Perception App. PRiSM collaborators include *New Scientist* (New Scientist Live Festival), Manchester Science Festival, Oxford e-Research Centre, the BBC Philharmonic and Barbican Centre. PRiSM's annual Future Music event at RNCM launched this year and features current developments in new music and technology, including Artificial Intelligence, Virtual Reality and Live Coding, asking what possibilities lie ahead for the music creators of the future.

www.rncm.ac.uk/prism

About the performers



William Cole

William Cole conductor

William Cole made his American debut conducting Philip Venables's *4.48 Psychosis* at the Prototype Festival in New York in January this year. With a repertoire from Baroque opera to new compositions, other recent highlights include tonight's debut with Britten Sinfonia, Hans Abrahamsen's *Schnee* with the Royal Northern Sinfonia and Purcell's *The Fairy Queen* for Waterperry Opera Festival.

Active in the opera house and the concert stage, recent and future engagements include projects with the Royal Opera, Covent Garden, English National Opera, English Touring Opera, Operá National du Rhin, Music Theatre Wales and the Grange Festival.

He is also a committed exponent of new and experimental work and is Music Director of Filthy Lucre, an immersive mixed-genre collective with whom he has worked with artists from the worlds of dance, sculpture, and film in music from Xenakis to The Clash. This season he will take part in Birmingham Contemporary Music Group's NEXT programme.

Recent performances of his own compositions include *The Bells of Lübeck* at the Bournemouth Symphony Orchestra's 2017 Composers' Day, *Her Face Was Full of Woe* by Anne Denholm, Harpist to HRH The Prince of Wales, in London and Bangkok, and *Versa Est in Luctum* for Britten Sinfonia, alongside projects with

ensembles including CHROMA, Psappha and the BBC Singers.

William Cole studied at the Royal Academy of Music, where he was a Répétiteur Fellow.



Marta Fontanals-Simmons

Marta Fontanals-Simmons mezzo-soprano

Praised for her 'warm mezzo' (*The Telegraph*) and being 'velvet-voiced' (*The Daily Telegraph*), British-Spanish mezzo-soprano Marta Fontanals-Simmons recently made critically acclaimed house and role debuts at the Royal Opera House, Covent Garden, as Siébel (*Faust*) and as Hel in the world premiere of Gavin Higgins's *The Monstrous Child* at the Linbury Theatre.

Highlights this season include her house and role debut at English National Opera as Eurydice the Woman in Daniel Kramer's new production of Birtwistle's *The Mask of Orpheus*, her house debut as Jennie Hildebrand (*Street Scene*) for Opéra de Monte-Carlo and her return to the Teatro Real, Madrid, for *Vlasta (The Passenger)*. In concert she will perform Elgar's *Sea Pictures* with the Royal Philharmonic Orchestra and Stravinsky's *Pulcinella* with the City of Birmingham Symphony Orchestra.

Recent operatic highlights include Amando (*Le Grand Macabre*) with the NDR Elbphilharmonie Orchestra and Alan Gilbert, Second Lady (*The Magic Flute*) for Glyndebourne Festival

Opera, Jennie Hildebrand at the Teatro Real, Cherubino (*The Marriage of Figaro*) for Garsington Opera and at the Théâtre des Champs-Élysées, the title-role in *La Cenerentola* for Diva Opera and Kate Pinkerton (*Madama Butterfly*) for Glyndebourne Tour and Grange Park Opera.

On the concert platform, recent highlights include the European premiere of Alasdair Nicolson's *Shadows on the Wall – Five Hauntings* at the Barbican, Berlioz's *La captive* with the BBC Symphony Orchestra, Verdi's Requiem with the Philharmonia Orchestra at the Royal Festival Hall, Vaughan Williams's *Serenade to Music* with Sakari Oramo at the Last Night of the Proms, Mendelssohn's *Elijah* with the CBSO at Birmingham Symphony Hall, Ravel's *L'enfant et les sortilèges* with Stéphane Denève and the Radio-Sinfonieorchester Stuttgart, Mozart's Requiem with the Royal Philharmonic Orchestra, Bach's Mass in B minor with Ryan Wigglesworth at the St Endellion Festival, *Messiah* with Laurence Cummings at the London Handel Festival, Stravinsky's *Les noces* at the Queen Elizabeth Hall, and Haydn's *Harmoniemesse* with the Royal Philharmonic Orchestra. In recital she has performed with pianists including Roger Vignoles, Simon Lepper and Iain Burnside.

She is a keen exponent of contemporary music and has created the role of Ursula in David Bruce's *Nothing*, a co-production between the Royal Opera House and Glyndebourne; recorded two new song-cycles (*Damsel, Wife, Witch* by Glyndebourne then Composer-in-Residence Lewis Murphy and *Letters from Home* by Benjamin Ellin); and performed Jonathan Harvey's *Songs of Li Po* with Richard Baker at the Barbican.

Marta Fontanals-Simmons trained at the Guildhall School of Music & Drama, where she was awarded the Gold Medal, and was a Jerwood Artist at Glyndebourne for the 2015–16 season.

Britten Sinfonia

Just over 25 years ago, Britten Sinfonia was established as a bold reimagining of the conventional image of an orchestra. A flexible ensemble comprising the UK's leading soloists and chamber musicians came together with a unique vision: to collapse the boundaries between old and new music; to collaborate with composers, conductors and guest artists across the arts, focusing on the musicians rather than following the vision of a principal conductor; and to create involving, intelligent music events that both audiences and performers experience with an unusual intensity.

The orchestra is named after Benjamin Britten, in part a homage to its chosen home of the East of England, where Britten's roots were also strong. But Britten Sinfonia also embodies its namesake's ethos. Its projects are characterised by a rich diversity of influences and artistic collaborators, and always underpinned by a commitment to uncompromising quality, whether the orchestra is performing at New York's Lincoln Center or in Lincolnshire's Crowland Abbey. Britten Sinfonia musicians are deeply rooted in the communities with which they work, with an underlying philosophy of finding ways to reach even the most excluded individuals and groups.

Today Britten Sinfonia is heralded as one of the world's leading ensembles. It is an Associate Ensemble here at the Barbican, Resident Orchestra at Saffron Hall in Essex and has residencies in Norwich and Cambridge. It presents an annual chamber music series at the Wigmore Hall and appears regularly at major UK festivals, including the Aldeburgh, Brighton and Norfolk and Norwich festivals and the BBC Proms. Over the past year the orchestra has broadcast live to more than a million people worldwide from the Sistine Chapel and toured to Amsterdam, Paris and Bilbao. This season it tours to the USA, Mexico, China and much of Europe. It is a BBC Radio 3 Broadcast Partner and has award-winning recordings on the Hyperion and Harmonia Mundi labels.

Recent and current collaborators include Keaton Henson, dancer/choreographer Pam Tanowitz and theatre director Ivo van Hove, with commissions from Thomas Adès, Gerald Barry, Shiva Feshareki, Emily Howard, Brad Mehldau and Mark-Anthony Turnage. The orchestra was also a commissioning partner

in the European premiere of *Reich/Richter*, which took place at the Barbican last month.

Outside the concert hall, Britten Sinfonia musicians work on creative and therapeutic projects with pre-school children, teenagers, young carers, people suffering from dementia, life-time prisoners and older people at risk of isolation. The orchestra's annual OPUS competition offers

unpublished composers the chance to receive a professional commission and unearth new, original and exciting UK compositional talent. Members of Britten Sinfonia Academy, the orchestra's youth chamber ensemble for talented young performers, have performed in museums, improvised with laptop artists, led family workshops and appeared at the Latitude Festival.

Britten Sinfonia

Violin

Jacqueline Shave

Cello

Zoë Martlew

Flute/Alto Flute

Sarah O'Flynn

Clarinet/ Bass Clarinet

Joy Farrall

Percussion

Owen Gunnell

Harp

Olivia Jageurs

Piano

Dawn Hardwick

This evening's performance is taking place using digital scores supplied by nkoda as part of a major Britten Sinfonia digital project supported by the City of London Corporation

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